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REMARKS

Claims 1-12 are pending in the present application. Claim 5 has been amended and Claim 13 has been added, leaving Claims 1-13 for consideration upon entry of the present amendment.

Reconsideration and allowance of the claims are respectfully requested in view of the above amendments and the following remarks.

First Claim Rejection Under 35 U.S.C. § 103(a)

Claims 1-3 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over U.S. Patent No. 5,736,002 to Allen et al. in view of U.S. Patent Publication No. 20002/0072228A1 to Kuo. Applicants respectfully traverse this rejection.

U.S. Patent No. 5,736,002 to Allen et al. (hereinafter "Allen") generally describes to a process for patterning films of copper or copper based alloys.

U.S. Patent Publication No. 20002/0072228A1 to Kuo (hereinafter "Kuo") generally describes a method of forming a fuse using plug material in contrast to prior art processes that form fuses from metal layers. The method includes fabricating a grooved W fuse from W plugs that are surrounded by a guard ring formed of metal lines and plugs. The method permits control of the remaining oxide thickness on a grooved tungsten fuse during a fuse window etching process.

For an obviousness rejection to be proper, the Examiner must meet the burden of establishing a *prima facie* case of obviousness. *In re Fine*, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988). Establishing a *prima facie* case of obviousness requires that all elements of the invention be disclosed in the prior art. *In Re Wilson*, 165 U.S.P.Q. 494, 496 (C.C.P.A. 1970).

Further, even assuming that all elements of an invention are disclosed in the prior art, an Examiner cannot establish obviousness by locating references that describe various aspects of a patent applicant's invention without also providing evidence of the motivating force which would have impelled one skilled in the art to do what the patent applicant has done. *Ex parte Levengood*, 28 U.S.P.Q.2d

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1300 (Bd. Pat. App. Int. 1993). The references, when viewed by themselves and not in retrospect, must suggest the invention. *In Re Skoll*, 187 U.S.P.Q. 481 (C.C.P.A. 1975).

Applicants respectfully assert that a prima facie case of obviousness has not been established against Claims 1-3. Independent Claim 1 is reproduced below for convenience.

1. A process for milling copper metal from a substrate having an exposed copper surface, the process comprising:

absorbing a halogen gas onto the exposed copper surface to generate reaction products of copper and the halogen gas;

removing unreacted halogen gas from the surface; and

directing a focused ion beam onto the surface to selectively remove a portion of the surface comprising the reaction products.

In independent Claim 1, the halogen gas is absorbed onto the exposed copper surface to generate reaction products of copper and the halogen gas. Unreacted halogen gas is then removed from the surface. A prima facie case has not been established because none of the cited references, individually or in combination, teach or suggest absorbing a halogen gas onto the exposed copper surface to generate reaction products of copper and the halogen gas. Moreover, the cited references fail to teach or suggest removing unreacted halogen gas from the surface and subsequently directing a focused ion beam onto the surface to selectively remove a portion of the surface comprising the reaction products of copper and the halogen gas.

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Allen discloses and suggests anisotropically introducing an oxidant-type reactant species (X) at an angle generally perpendicular to the major surface of the patterned mask. The anisotropic introduction of the reactant species may be carried by way of ion implantation or plasma reactor (Column 6, lines 6-21). Ion implantation or plasma reactors typically include exposing a gas mixture to an energy source to produce the reactant species, which are then directed to the substrate of interest. Thus, the reactant species disclosed by Allen are not gases but reaction products produced by exposing the gases to an energy source. The reactant species themselves are not gases. This is clearly evident in Table 2 of Allen. Table 2 provides recipes for an oxygen plasma and a chlorine plasma. A gas mixture at defined flow rates is exposed to a RF energy source of a defined magnitude to produce the reactant species from the gas. In contrast, Applicants' claims are directed to absorbing a halogen gas onto the exposed copper surface to generate reaction products of copper and the halogen gas. There is no plasma mediated processing. The halogen gas is absorbed by the surface. Thus, the reactant species contemplated by Allen are markedly different from the use of a gas as described in the present application. For example, the introduction of a gas into a reactor, by its nature, will not be anisotropic because it is a gas.

Moreover, Allen fails to remove unreacted halogen gas from the surface. Since Allen exposes the surface to reactant species not halogen gas, there is no absorption of halogen gas on the surface. Thus, there can be no removal of halogen gas from the surface since Allen employs reactant species. The Office Action refers to Column 10, lines 3-10 to provide support for removing unreacted halogen gas. However, it is respectfully submitted that this portion of the specification does not teach or suggest removing unreacted halogen gas from the substrate surface. In the subsequent paragraph (Column 10, lines 9-20), the patentees refer to purging the vaporization chamber with an inert gas. There is no disclosure or suggestion of removing unreacted halogen gas from the substrate surface. The atmosphere above the surface and within the chamber is purged.

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Likewise, in Kuo, there is no disclosure or suggestion of absorbing a halogen gas. Similar to Allen, Kuo specifically refers to the use of plasma mediated process for generating reactive species. At paragraph 0019, Kuo discloses that the plasma includes a halogen gas as the reactive component in the feedstream of the plasma exposure process. Thus, the plasma which contains the reactive species is formed from the halogen gas. This is markedly different from absorbing a halogen gas onto an exposed copper surface to generate reaction products of copper and the halogen gas.

As all elements of independent Claim 1 have not been taught, this claim is patentable over the cited references, individually or in combination. Given that Claims 2-3 each further limits and ultimately depends from Claim 1, they too are patentable.

Second Claim Rejection Under 35 U.S.C. § 103(a)

Claim 5 stands rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over U.S. Patent No. 5,736,002 to Allen et al. in view of U.S. Patent Publication No. 20002/0072228A1 to Kuo as applied to Claims 1-3, and further in view of U.S. Patent No. 6,194,720 to Li et al. Applicants respectfully traverse.

U.S. Patent No. 6,194,720 to Li (hereinafter "Li") is generally directed to preparation of transmission electron microscope samples using a focused ion beam process. In an exemplary staged milling process, the beam current taught by Li comprises an energy from about 2,500 to 3,000 picoAmps.

Applicants' Claim 5 ultimately depends from independent Claim 1 and as such, include all of the features found in this base claim. For reasons previously discussed, the cited references, Allen and Kuo, fail to teach or suggest absorbing a halogen gas onto the exposed copper surface to generate reaction products of copper and the halogen gas. Moreover, the cited references fail to teach or suggest removing unreacted halogen gas from the surface and subsequently directing a focused ion

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beam onto the surface to selectively remove a portion of the surface comprising the reaction products of copper and the halogen gas. Li fails to compensate for these deficiencies.

In Li, there is no disclosure or suggestion of absorbing a halogen gas onto the exposed copper surface to generate reaction products of copper and the halogen gas nor is there any disclosure or suggestion for removing unreacted halogen gas from the surface and subsequently directing a focused ion beam onto the surface to selectively remove a portion of the surface comprising the reaction products of copper and the halogen gas.

Accordingly, a prima facie case has not been made based on a combination of the cited references, and the rejection of Claim 5 should be withdrawn.

Third Claim Rejection Under 35 U.S.C. § 103(a)

Claims 6-10 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over U.S. Patent No. 5,736,002 to Allen et al. in view of U.S. Patent Publication No. 20002/0072228A1 to Kuo as applied to Claims 1-3, and further in view of U.S. Patent No. 6,211,527 to Chandler et al. Applicants respectfully traverse.

U.S. Patent No. 6,211,527 to Chandler et al. (hereinafter "Chandler") is generally directed to focused ion beam milling and an etch assisted gas for making connections to conductors buried under dielectric layers.

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Applicants assert that a prima facie case of obviousness has not been established against Claims 6-10. Independent Claim 6 is reproduced below for convenience.

Claim 6. A process for focused ion beam milling multiple layers of a substrate, wherein the substrate comprises an insulating layer in contact with an underlying copper surface, the process comprising:

exposing the substrate to a noble gas halide within an enclosed chamber;

directing a focused ion beam onto a portion of the insulating layer and removing the portion to expose the underlying copper surface;

absorbing a halogen gas onto the exposed copper surface to generate reaction products of copper and the halogen gas;

removing unreacted halogen gas from the surface; and

directing a focused ion beam onto the surface to selectively remove a portion of the surface comprising the reaction products.

Chandler fails to compensate for the deficiencies of the other cited references since Chandler fails to teach or suggest, individually or in combination, a process comprising, inter alia, absorbing a halogen gas onto the exposed copper surface to generate reaction products of copper and the halogen gas.

As all elements of independent Claim 6 have not been taught, this claim is patentable over the cited references, individually or in combination. Given that Claims 7-10 each further limits and ultimately depends from Claim 6, they too are patentable.

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Fourth Claim Rejection Under 35 U.S.C. § 103(a)


Claim 12 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over U.S. Patent No. 5,736,002 to Allen et al. in view of U.S. Patent Publication No. 20002/0072228A1 to Kuo and U.S. Patent No. 6,211,527 to Chandler et al as applied to Claims 6-10, and further in view of U.S. Patent No. 6,194,720 to Li et al. Applicants respectfully traverse.

For reasons previously discussed, the cited references fail to teach or suggest absorbing a halogen gas onto the exposed copper surface to generate reaction products of copper and the halogen gas. Accordingly, it is requested that the rejection of Claims 12 be withdrawn.

It is believed that the foregoing remarks fully comply with the Office Action and place the application in condition for immediate allowance, which action is earnestly solicited. If there are any fees due in connection with the Response, or otherwise, Applicants' attorneys authorize that such fee be charged to Deposit Account No. 09-0458.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

A marked-up version of Claim 5 follows:

5. (Amended) The process according to Claim 4, wherein the focused ion beam current comprises an energy from about 500 to 3,000 picoAmps.